Exemption No. 7404

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
RENTON, WASHINGTON 98055-4056

In the matter of the petition of **Airbus Industrie** for an exemption from § 25.807(f)(4) of Title 14, Code of Federal Regulations	**Regulatory Docket No. 30052**

DENIAL OF EXEMPTION

By letter dated May 9, 2000, Mr. Wolfgang Didszuhn, Vice President, Product Integrity, Airbus Industrie, 1 Bond Point Maurice Bellontie, 31707, Blagnac, Cedex, France, petitioned for an exemption from the requirements of § 25.807(f)(4) of Title 14, Code of Federal Regulations (14 CFR). This exemption, if granted, would permit an interior arrangement that does not provide 60-feet or less between passenger emergency exits in the side of the fuselage on an Airbus Model A340-600.

The petitioner requests relief from the following regulation:

Section 25.807(f)(4) requires that the edge to edge distance between adjacent passenger emergency exits, on each side of the fuselage, be no greater than 60-feet. Note: This requirement was relocated to this section as of amendment 25-94.

Related Sections of the Federal Aviation Regulations (FAR):

Section 25.2(b) requires compliance with § 25.807(c)(7) (in effect on July 24, 1989) for any modification to an airplane that was manufactured after October 16, 1987. Section 21.183(f) requires compliance with § 25.807(c)(7) (in effect on July 24, 1989), for an airplane that was manufactured after October 16, 1987, in order for the airplane to be eligible for a standard certificate of airworthiness.

Section 121.310(m) requires that, except as provided by §121.627(c) and except for an airplane used in operations under this part on October 16, 1987, and having an emergency exit configuration installed and authorized for operation prior to October 16, 1987, for an airplane that is required to have more than one passenger emergency exit for each side of the fuselage, no passenger emergency exit shall be more than 60-feet from any adjacent passenger emergency exit.

The petitioner's supportive information is as follows:

"Summary of the Petition

"Airbus Industrie, Blagnac, France, petitions for an exemption from the pertinent requirements of 14 CFR 25.807(f)(4) and related requirements of 14 CFR 25.2(b), 25.183(f) and 121.310(m) to the extent necessary to permit it to certify, as compliant with FAR 25 Amendment 25-67, its A340-600 aircraft with a distance between exit door pairs 2 and 3 in excess of 60-feet.

"This is a petition for exemption from 14 CFR 25.807(f)(4), and related parts, of the Federal Aviation Regulations (FAR 25.807(f)(4)). This petition is filed on behalf of Airbus Industrie in accordance with FAR 11.25, Petitions for rulemaking or exemptions. Petitioner argues, as further explained below, that the granting of this petition would not adversely affect safety, and the design of the aircraft involved is such that they provide a level of safety equal to that provided by the rules from which the exemption is sought.

"The exemption is sought from FAR 25.807(f) at Amendment 91. While the contents of this subparagraph have not changed during its years of existence, the location has moved or it has disappeared for some time. The actual certification basis of the A340-600 does not contain the requirement. The re-introduction of the text at its current location leads to an inconsistency within subparagraph FAR 25.807(f). While part (f)(1) requires the most effective means of passenger evacuation, parts (f)(2), (3), and (4) contain provisions that, as discussed herein, do not provide for the most effective means for passenger evacuation in the configuration presented.

"Airbus Industrie is a manufacturer of transport category aircraft with worldwide customers, including many in the U.S. For that reason, Airbus is required to obtain certification from the FAA for any of our aircraft that are to be operated by our customers in accordance with either Part 121 or Part 129 of the Federal Aviation Regulations. One new model of our product line, the A340-600, is a wide body aircraft seating up to 440 passengers. Because of its unique cabin design, the aircraft cannot accommodate 220 people between two Type A exit doors that comply with the above requirement that they be separated by no more than 60-feet. In fact, an optimum (from the safety viewpoint) layout of the aircraft exit doors locates door pairs 2 and 3 such that approximately 74 feet separate them.

"Therefore, as discussed below, Airbus seeks an exemption from the rules cited above, to the extent necessary to allow FAA certification of the aircraft to FAR 25 standards (with exemption), operation by U.S. airlines to the standards of FAR 121, and airworthiness certification of aircraft to be registered in the U.S. but operated, under FAR 129, by non-U.S. operators.

"Regulatory History

"It is perhaps easiest to begin by quoting extensively from the preamble to the final rule that put in place the regulations from which we seek exemption. The following discussion is quoted verbatim from the preamble to Amendment 25-67 of the FAR, published June 16, 1989:

'Since 1967, the Federal Aviation Administration (FAA) has regulated the location of emergency exits on airplanes by requiring that an exit be provided for every specified number of passengers, that an exit be located *where it would allow the most effective means of passenger evacuation* [emphasis supplied], and that exits be distributed as uniformly as practicable taking into account passenger distribution (14 CFR 25.807). An underlying assumption has been that a uniform distribution of exits accounting for passenger distribution results in reasonable seat-to-exit and exit-to-exit distances.

'However, some recent exit configurations have exit distances that are greater than those envisaged when the exit rule was adopted. Of the new wide-body transports that were being designed when the rule was adopted, the Boeing Model 747 had a maximum distance between exits of 44 feet; the McDonnell Douglas Model DC-10, 47 feet; and the Lockheed Model L-1011, 50 feet. (All figures are rounded off.) Basic narrow-body transport models typically had shorter distances. Derivative configurations of these models show an increase in typical distances. Exit-to-exit distance, originally 50 feet in the Model L-1011-385-1, increased to nearly 70 feet in a later model, the L-1011-385-3. The Boeing 747 showed an increase from 44 feet in the 747-100, -200, and -300 models to nearly 70 feet in the 747-200 and 747-300 models with the No. 3 exits deactivated. A recent certification request proposed a derivative configuration with a distance substantially greater than 80 feet. The FAA denied this request. These recent cases of exit configuration design indicate that the exit distribution requirement of §25.807(c) alone is ineffective in preventing increases in escape path distances. While the agency recognizes that exit distance considered alone is not dispositive of the conditions which provide for a safe evacuation, under our current state of safety knowledge, this factor is clearly an important variable. As discussed below, however, the agency considers it preferable that a performance standard for evacuation be employed in the future, so as not to artificially constrain design options. With the specific intent of developing the information necessary to propose such a performance standard to replace (among other factors affecting safe evacuation) this artificial exit distance limitation, the agency will gather the best available safety expertise in a formally chartered advisory committee to consider and report on the best means for achieving that end.

'The agency's concern over the significance of escape path distance recently increased in connection with type certification activities for a derivative of the Boeing Model 747 (B-747), necessitating this action in the interim, until better knowledge permitting development of a performance standard becomes available. In September 1984, at the request of the Boeing Company (Boeing), the Seattle Aircraft Certification Office (ACO) approved a modification of the B-747 which would deactivate a pair of overwing exits and reduce the maximum passenger capacity of the main deck by 110, from 550 to 440. The Seattle ACO approved the modification on the basis that such a modification was within the requirements of the regulations at that time. The FAA received many letters from the public objecting to the deactivation of emergency exits. In response to the public objections, the FAA Administrator asked the Office of Airworthiness (presently the Aircraft Certification Service) for a review of the ACO action. The review, dated March 1, 1985, found that the B-747, as modified, fully met all applicable rules and that no exemptions, waivers, or special conditions were granted or considered. Notwithstanding this conclusion, on June 12, 1985, the FAA Administrator wrote a letter to a number of U.S. air carriers strongly encouraging them to maintain the original number of emergency exits on their passenger-carrying Boeing 747 airplanes, because of safety concerns not addressed by the rule.

'On June 24, 25, and 26, 1985, the House Subcommittee on Investigations and Oversight heard testimony from witnesses opposed to exit deactivations and from the FAA Administrator. The Administrator promised the committee a review of all issues raised in the letters received by the FAA and in testimony given before the committee. The review was summarized in a report to the Administrator, dated August 5, 1985. It found that the approval for design modifications to B-747 airplanes was technically valid in accordance with the regulations but that issues raised by the public added next emphasis and perspective to the issue of escape path distances. The report concluded that all of the issues raised by the public questioned the efficacy of the rules rather than the validity of the approval. The report stated that the FAA would hold a Public Technical Conference on emergency evacuation. As a result, an Emergency Evacuation Task Force was formed in Seattle, Washington, in September of 1985. The task force consisted of members of the interested public and was chaired by the FAA. The task force reviewed recent design, maintenance, and operational experience of new generation of narrow- and wide-body transports.

'It examined the full range of emergency evacuation topics, including passenger emergency exits, cabin configuration, emergency evacuation demonstrations, evacuation slides, crewmember duties and training, and passenger safety information. Although no consensus was reached by the task force, the task force efforts were helpful to the FAA in its own ongoing efforts to improve emergency evacuations. Unfortunately, the task force did not provide any basis for a performance standard to address the concerns raised by increasing exit distances.'

'The FAA reviewed the issues surrounding the Boeing approval as well as information gained on modifications of other wide-body transport airplanes, information received from flight attendants who are knowledgeable about emergency evacuation procedures, and information from the public and other interested persons. As a result, the FAA decided that the rules on number and location of passenger emergency exits were not adequate to maintain the original intent of those rules that exits be located to provide an opportunity for passenger evacuation in an emergency, because aircraft designs had significantly changed in the over 20 years since the rule was written.

'The agency's reassessment of the rules in light of recent aircraft designs and events has confirmed the importance of the distance between exits and the potential impact of excessive distance on the chances of passenger survival in an emergency. Accordingly, in the absence of a performance standard which provides acceptable safety, the FAA is amending Parts 21, 25, and 121 of the Federal Aviation Regulations (FAR) to prohibit any passenger emergency exit from being located more than 60-feet from any adjacent passenger emergency exit. The FAA has determined that the specification of the distance between exits along with the existing uniform distribution rule is sufficient to provide the appropriate distance between a passenger seat and an emergency exit, though the preferable alternative would be a performance standard. For the purposes of this rule, the distance between exits is measured along a line parallel to the airplane's longitudinal axis for exits on the same deck and on the same side of the fuselage.

'This rulemaking action covers only one of many factors affecting cabin evacuation. The FAA considers evacuation within a systems or 'holistic' framework, i.e., a number of interrelated factors affect the success of an evacuation. These factors include: cabin attendant training, fuselage attitude, door design, door reliability, chute design and reliability, chute inflation times, aisle design, seat materials, exit row lighting, aisle lighting, crew check lists, passenger safety information, cabin configuration, and other factors.

'The FAA is addressing these and other related issues by establishing an emergency evacuation advisory committee to develop recommendations for an evacuation performance standard and appropriate further modifications and additions to the agency's existing evacuation regulations. The committee will include representatives of crewmembers, airlines, manufacturers, and other interested organizations. The committee will provide the FAA with recommendations on areas which concern improved specification of emergency evacuation regulations and other new techniques which should enhance cabin evacuation. Specifically, the committee will be tasked to design a performance standard against which safe evacuation capability of existing and new aircraft designs can be measured in order to replace artificial exit distance limitations and other non-performance oriented design criteria mandated by this and other regulations. This group will be asked to submit recommendations on airplane evacuation standards by July 1st, 1991, and to review all relevant cabin evacuation issues that the FAA asks it to consider, as well as issues raised by passengers, the National Transportation Safety Board, and the Congress. The FAA will use the committee's recommendations as a basis for reformulating the agency's evacuation regulations, if warranted by analysis in accordance with Executive Order 12291. While such a reformulation into an evacuation performance standard is hoped to obviate the need for distance limitations established by this final rule, the FAA finds that, in the interim until such performance standards are available, distance limits between emergency exit doors are necessary in the interest of airline passenger safety.

'On October 20, 1987, the FAA published Notice of Proposed Rulemaking No. 87-10 (Notice No. 87-10) [52 FR 39190] which proposed to establish new standard limits on transport category airplanes for the distance between any passenger seat and the nearest emergency exit and the distance between exits. On March 2nd, 1988, the Administrator testified before the House Committee on Public Works and Transportation, Subcommittee on Investigations and Oversight. In that testimony the Administrator stated that, having reviewed the public comments, the FAA planned to issue a final rule to prescribe a new standard to limit the distance between exits.'

"Changes in our state of knowledge

"Since this rule was first believed to be necessary in the mid-1980's, there has been a considerable amount of work done to improve our understanding of the factors that influence successful emergency evacuations. This new information provides substantial evidence that the design presented by the petitioner, though it does not meet the requirements of the subject regulation, is of equivalent safety to alternative designs that would meet the regulation. In particular, as discussed more fully below, new information comes not only from the development and use of competitive evacuation trials to more accurately demonstrate the importance of different variables in an emergency evacuation, but also from modeling of evacuation flows in both theoretical and realistic scenarios. The validation of these models, coupled with the improved understanding of passenger behavior that comes from the competitive evacuation trials carried out at Cranfield University, demonstrates the overwhelming importance of queue length, rather than absolute seat-to-exit distance, in providing quick emergency egress.

"Competitive Evacuation Trials

"One of the most significant developments in improving our understanding of the factors involved in emergency evacuations, and how best to perform emergency evacuation experiments involving humans, has been well developed by Professor Helen Muir at Cranfield University. (see, e.g., 'The Effect on Aircraft Evacuation of Competitive Passenger Behaviour Given Specified Constraints,' C. Morrison and H. C. Muir, Technical Report, Cranfield Institute of Technology, 1989.) Professor Muir's group developed the concept of trying to emulate realistic evacuation behavior of airline passengers by providing a monetary incentive to those who got out of the aircraft earliest. Using an evacuation simulator based on a single aisle transport design, she was able to show clearly that this method of simulation was far more realistic than previously used evacuation trials that did not employ any incentive. It is now widely accepted that, though of a different kind, the incentive provided in these simulations far more closely approaches the passenger behavior actually experienced in real emergency evacuations involving the fear of fire.

"First used to explore the effect of cabin configuration near a 'Type III' exit, the method has since been used to explore a number of factors. In all of the competitive evacuation trials, some of which have been sponsored in part by FAA, video records show quite clearly the formation of a queue at the exit door (or at the flow-limiting obstacle, such as a monument in the aisle). In no case ever run at Cranfield under competitive evacuation conditions has the distance to the exit been shown to be a relevant factor in determining evacuation time. Clear video records demonstrate that queuing at 'choke points,' not large seat-to-exit distances provide the delays experienced in evacuations.

"This new information from Cranfield was obtained under a much more realistic test scenario than was available in the 1970's, which is the time at which the data used in the FAA rulemaking was obtained.

"<u>Evacuation Modeling</u>

"Equally important in contributing to our understanding of the effect of distance from seat to exit on time to evacuate the aircraft is the modeling work conducted in the time since the issuance of the FAA Notice of Proposed Rulemaking (NPRM; 52 FR 39190, October 20, 1987; Docket 25419; Notice 87-10). In particular, the work of Professor E. R. Galea and his colleagues at the Fire Safety Engineering Group, University of Greenwich, has been shown to be quite reliable in predicting the behavior of passengers under realistic aircraft emergency evacuation demonstration scenarios.

"The advantage of using the modeling approach is that many alternative scenarios can be tested, and many cabin configurations can be analyzed, to determine the effect of various layouts on cabin evacuation time. Typically dozens or even many hundreds of simulations runs are performed using a Monte-Carlo type approach in the modeling. In addition, the use of this modeling capability permits comparison of the evacuation capability of certificated designs with that of proposed designs.

"The 'airEXODUS' model of Galea is the one to which we will refer in the remainder of this petition. This model was employed by petitioner to evaluate the evacuation performance of the A340-600 design with exits, fully compliant with all emergency evacuation design requirements but for the distance between door pairs 2 and 3, which is approximately 74 feet. ('An Analysis of the Evacuation Performance of the A340-600 Four Door Concept using the airEXODUS Evacuation Model,' Report prepared for Airbus Industrie, 14 May 1999, Professor E. R. Galea et al, Fire Safety Engineering Group, University of Greenwich, see Appendix) [available in the docket]. For the purpose of this modeling, 220 passengers were seated in the area between exit pairs 2 and 3 (zone 2). This A340-600 design, using 8 abreast seating (2-4-2), was compared with a similar already FAA certificated design (the ACC design) which employed 10 abreast seating (3-4-3) and 220 passengers seated between 2 type A door pairs in zone 2 separated by just under 60-feet, a configuration which complies with the rule under discussion. The difference between these two designs is, of course, only the cabin width, which in turn requires that the spacing between the doors be increased proportionally. The narrower cabin design of the A340-600 requires a longer cabin section to place 220 people between door pairs 2 and 3.

"The airEXODUS model is typically used (as was the case here) to investigate evacuation times for two broadly different scenarios: an 'optimal scenario' and a 'sub-optimal scenario.' In both cases, a range of distributions of passenger exit flows, hesitation times and so on derived from actual certification test results are used. The major difference between the cases is that in the optimal case, the flow of passengers to exits is such as to minimize evacuation time, and they are *not* constrained to use the nearest available exit. In the sub-optimal case, passengers are constrained to use the nearest available exit. In the sub-optimal case, passengers travel shorter distances on average. Paradoxically, however, because of the well-established behavior of passenger flows in real evacuation trials, the evacuation using shorter average seat-to-exit pathways actually takes longer than in the optimal case. In the optimal case, average distance traveled is increased, but the flow rate is faster and the evacuation takes less time. In other words, shorter distances traveled do not always lead to more rapid evacuation times. It is believed, based on accident investigation research and records, that the optimal case more accurately reflects certification test results, whereas the sub-optimal case more accurately simulates behavior in a real accident. Note that most present-day safety announcements made by flight attendants call attention to the “nearest” emergency exits, which in the event may not be the optimum exits to use.

"The simulation results (see Appendix for details) for the A340-600 in the 'optimal' scenario suggest that evacuation times (within 95 percent confidence limits) for all passengers not including crew will be in the range of 68.7-75.6 seconds for 440 passengers, while for the alternative ACC design the range is 65.6-76.0 seconds. The results for 'sub-optimal' scenarios are 88.8-99.4 seconds, while for the ACC configuration the 'sub-optimal' scenario produces an expected range of 92.5-101.4 seconds. As noted earlier, the 'optimal' scenario can be compared with performance to be expected in a certification test demonstration, while the 'sub-optimal' scenario can be compared to one encountered in a real evacuation, involving confusion among passengers and less efficient behavior. The report clearly indicates that both aircraft designs can be expected to successfully pass FAA performance criteria under present certification evacuation test regulations. Of course, an aircraft very closely resembling the ACC configuration has already been certificated by FAA.

"In comparing the two model results (which actually derive from 1800 individual model runs for the project), passengers in the A340-600 scenario traveled some 1.1 m further on average than passengers in the ACC scenario. (Note that the additional distance traveled does not more closely approximate the 4-meter plus additional door spacing in zone 2, because only a small fraction of the total passengers are in any way affected by this added distance.) In both configurations, passengers tend to waste the same amount of time, standing stationary in congestion regions. This wasted time is approximately 22 seconds, which represents 30 percent of the total evacuation time. It is clear that the additional length of the A340-600 design compared to the FAA certificated ACC design has no adverse effect on evacuation performance. It is also clear that this modeling independently confirms the video evidence from Muir's Cranfield trials—queuing at choke points (in the cases modeled here, the doors themselves) gives rise to the delays in emergency evacuation. Distance to the exit is not a significant or limiting factor.

"This highly sophisticated modeling shows clearly that the additional door spacing in zone 2 does not adversely affect the evacuation capability of the A340-600. The A340-600 design with a 74 foot door-door spacing in zone 2 provides a level of safety equivalent to that achieved by an already certificated configuration which has a wider cabin, and is thus able to comply with the rule by having 60-feet between exit door pairs in zone 2. Both designs incorporate 4 Type A doors at the corners of zone 2, and both have 220 passengers in this zone. The evacuation capability of both is almost identical, despite the dimensional difference which arises from the differences in cabin width.

"The Scenario Considered by FAA in the NPRM

"In the mid-1980's, when this issue first arose, the issue involved the removal of 20 percent of the exits from the main deck of the B-747, which gave rise to substantial public and Congressional concern about reducing the level of safety inherent in the design. The FAA did two detailed studies of the matter to determine if the then existing rules permitted deactivation or removal of these exits. In both studies (Office of Airworthiness Summary Report, 'Review of the Seattle Aircraft Certification Office Approval of a Design Change to Permit Removal of Exits from Boeing Model 747 Series Airplanes,' March 1, 1985, FAA, Docket No. 25419; and 'Report to the Administrator, Review of Issues Raised by the Public Pertaining to Deletion of the Over-wing Emergency Exits from the Boeing Model 747 Airplane,' August 5, 1985, FAA, Docket No. 25419) FAA concluded that there were no safety regulatory grounds whatsoever to require any maximum distance between exit doors based on the rules as they existed at that time.

"In order to provide a basis for creating a new regulation, and in the absence of any adverse service experience showing a need for this rule, FAA used a special evacuation scenario in its NPRM, one that had no basis in service experience. This scenario was found by reaching into the archives and finding a 1978 research report that considered various fuselage attitudes in a work comparing different flows between passenger compartments in artificially created situations. ('Passenger Flow Rates Between Compartments: Straight-Segmented Stairways, Spiral Stairways, and Passageways with Restricted Vision and Changes of Attitude,' FAA report FAA-AM-78-3, January 1978.) The scenario used in the NPRM involved substantial rolling of the floor in an evacuation simulator so that evacuees were not able to move through the aisle with the same speed that was achieved without the roll. The FAA used this scenario to demonstrate that there were conceivable scenarios under which speed in the aisle, and hence distance to the door, *could* be a factor in an evacuation.

"Of course this is true, since one can always envision a theoretical aircraft fuselage orientation in which it is not possible to easily navigate an aisle. The extreme case is one in which an aircraft is on its side, but this kind of scenario is not a realistic design point, as demonstrated by FAA's decision to permit some aircraft with more than 60-feet between exits to continue in operation, a decision that would not have been taken had this been viewed as an 'unsafe condition.' FAA states, in the preamble to Amendment 25-67, 'These tests were just one factor in the agency's decision.' No other factors have ever been defined.

"The use of the data in AM-78-3 in this manner is questionable, at best. The study was not done to compare actual evacuation flows in conventional aircraft cabins, but to compare two different kinds of stairway flows, one involving spiral stairs, and one involving straight stairs (both of which were already approved by FAA). The incorporation of 3 sets of double seats on one side of a 20 inch aisle, the other side bounded by a wall, was used to create a straight passageway for comparison sake—a baseline, as it were. In other words, the test set-up did not use actual aircraft cabin simulation, but an unusual system that did not represent (nor was it intended to represent) a real airline configuration. Certainly, the kinds of cabins in use today have no relationship whatsoever to those employed in these tests. As noted above, petitioner acknowledges that a *theoretical* argument that cannot be overcome is possible, noting the *theoretical* possibility that aisle roll can affect evacuation speed. In the *practical* sense it is also clear, however, clear that this has never been found to be a factor in a real accident.

"As discussed in the FAA's own words in the preamble to Amendment 25-67, '…the decision to establish a maximum distance of 60-feet between exits is not a decision based on specific provable data. Rather, in the absence of a technically acceptable evacuation performance standard, it is a decision based on a balancing of door distance in the total equation of cabin evacuation, that is how door distance interrelates with aisle design, exit row lighting, door design, chute inflation time, and other factors that go into the cabin evacuation scenario, *given our present understanding of the interrelationship of these variables.*' (emphasis supplied; 54 FR 26693, June 23, 1989)

"Petitioner argues that the new information developed in the past decade since the issuance of this rule, including that discussed herein, has clearly shown that a design such as that presented by the 4 door A340-600 configuration discussed herein has an equivalent level of safety to alternative designs that comply with the requirements of Amendment 25-67.

"<u>For Lack of a Performance Standard, a Temporary Rule</u>

"The preamble to Amendment 25-67 makes it clear that FAA was seeking a 'performance standard,' against which to measure the adequacy of the design of aircraft with regard to emergency evacuation. For many years, the industry had worked under the assumption that escaping from a hazardous environment, whether the hazard be from toxic fumes or fire, was the objective to be fostered by emergency evacuation design, as was specifically provided in the regulations. To perform well, evacuation should be possible in a short time, before threats to life become reality. The performance of an evacuation system was judged against the time it took to evacuate the aircraft, under carefully prescribed detailed conditions, and in no case could exceed 90 seconds.

"Unfortunately for the rulemaking objective for Amendment 25-67, this was an inadequate standard to apply, because all testing and analysis had shown that the 8 door versions of the B-747 would easily meet this criterion. The FAA therefore summarily abandoned the performance standard it had previously used—the maximum permissible evacuation time under carefully specified detailed test conditions—and added a new requirement, distance between exits. It did so noting "the agency considers it preferable that a performance standard for evacuation be employed in the future, so as not to *artificially* constrain design options." (emphasis supplied)

"With the specific intent of developing the information necessary to develop such a performance standard 'to replace this artificial exit distance limitation,' the agency convened a formally chartered advisory committee, which met in September of 1985, but it also failed to develop such a 'performance standard' to substitute for evacuation time. Thus, FAA took the position that 'in the interim, until such performance standards are available, distance limitations between emergency exit doors are necessary in the interests of airline passenger safety,' despite the lack of a demonstrated safety case.

"In the intervening years, considerable new information has been developed to show that the best minds in government and industry have been unable to develop a standard better than that which has been in use for many years: evacuation time. There are no serious proposals before any group to even consider, let alone adopt, any specific alternative performance standard.

"The putative temporary nature of this rule, and the length of time that has elapsed since its adoption, dictates that considerations of equivalent level of safety for a specific design should permit, as provided in FAR 11.25, exemptions in cases such as this one. While petitioner continues to participate in the Transport Engine and Issues Group of the agency's Aviation Rulemaking Advisory Committee, we are convinced that there is no credible short-term proposal that would provide the alternative 'performance standard' sought by the agency. Accordingly, equivalent level of safety considerations should prevail, on a case-by-case basis, based on clear and unambiguous state-of-the-art analysis as presented in the Appendix.

"Confusion Between Distance to the Exit and Time to Evacuate

"In its discussion of Amendment 25-67, and elsewhere, FAA has made reference to early research that indicated that distance to an exit has a substantial effect on survivability in an accident involving fire or toxic fumes. There have been serious misconceptions arising from such discussions. The basic misconception is now, based on research discussed above, seen to be the result of confusion between the number of people between the passenger and the exit, and the distance between the passenger and the exit, in a real or theoretical accident scenario. A 1964 FAA report, 'Human Factors of Emergency Evacuation,' (FAA-AM-65-7, Mohler et al) states that no passenger should be more than 22 feet from an exit. However, that statement was made with regard to full scale evacuation tests conducted in those times, without any modern escape equipment, specific evacuation performance determinations for which were completely unacceptable in today's environment. The two specific evacuation times cited in the report were 2 minutes 20 seconds, and 3 minutes, 30 seconds! It is clear that such performance is intolerable, and recommendations based on them are of little relevance when discussing today's equipment.

"A second report cited by FAA was 'Survival in Emergency Escape from Passenger Aircraft,' FAA AM-70-16, Snow et al, 1970. Here the pertinent statement cited by FAA was 'In all three accidents, the distance between initial seat location and the nearest usable exit tended to be greater among fatalities than survivors. This leads to the not unsurprising conclusion that it is better to sit closer to an exit that farther away.' This is, of course, a true statement in almost every conceivable condition, but it is not relevant to a decision to set limits on seat-to-exit distance. This is so because in any given real evacuation, it is better to be closer to the exit and have fewer people to block your way to the emergency exit, than to be farther back, with a longer queue between you and the emergency exit. As we have seen, based on new information developed since the rule was enacted, both sophisticated modeling and competitive evacuation trials show that the number of persons in the emergency exit queue is dispositive in determining evacuation time. Beginning the evacuation farther up the line, with a shorter queue before you, will result in a shorter evacuation time. In other words, the relevant measure is the *number of passengers* between you and the exit, not the *distance* between you and the exit. This has been repeatedly demonstrated by the work of Muir in evacuation trials, the work of Galea in modeling, and others. It is true that, for a *given* configuration, distance to the exit and number of passengers ahead of you in the queue are directly related, but that is not relevant to determining the *maximum* distance that should be permitted between exits. It would be relevant to determining the number of passenger seats between you and the exit, but this is not the performance standard chosen by FAA (though it might be a more relevant measure).

"Simply stated, many people who discuss this issue confuse evacuation *distance* with the *number* of people who would form in a queue to the exit. This becomes clear when one examines the modeling results comparing a certificated configuration with 220 people between pairs of Type A exits in a 3-4-3 seating configuration, with those for 220 people in a 2-4-2 seating configuration. Despite the latter's lack of compliance with the rule under discussion, both can easily comply with the relevant performance measure—escaping in the required short time, under the carefully specified detailed test conditions. It is the number of people in the queue, not the distance, that matters and the two configurations perform with equivalent levels of safety.

<u>"Specific Features that Reduce Evacuation Time for Unusual Floor Attitudes</u>

"There are three important features of the A340-600, developed since the time of the evacuation studies cited in the FAA rulemaking docket, that should be taken into account when evaluating the time required to evacuate in case of an emergency. These features are the floor proximity escape path lighting, as required by FAA regulations, the lack of easy break-over of the seats used in the aircraft, and handrails designed into the overhead stowage bins, a unique feature of Airbus aircraft. All of these features tend to reduce the concerns that are raised by any roll angle that is present during evacuation.

"Specifically, it has been well established that one of the major benefits to floor proximity lighting systems is to provide a reference plane of orientation to the subconscious, providing illumination of the floor plane and thereby facilitating more rapid evacuation in the case of a floor orientation that is not perpendicular to the vertical. This safety feature present on all modern aircraft was not present during the evacuation testing done in CAMI.

"Second, the Airbus cabin design for the A340-600 incorporates a well-proven and useful handhold along the bottom on both sides of the overhead storage bins. This continuous handhold runs the length of the cabin, and provides for much easier negotiation of the aisle in the event of an unusual orientation during evacuation.

"Finally, the modern '16-g' seats incorporated into the Aircraft do not provide for easy (25 lbs. applied force) break-over, as was the case in the aircraft seats employed for the evacuation testing cited in the CAMI report. The CAMI studies noted that the ready break-over of the old types of seats added to the difficulty of negotiating the aisle when the floor was in an unusual attitude. This is not the case for the A340-600, which employs seats that require far more break-over force and therefore provide more solid stability as handholds.

"Thus, all together, contrary to the cabin configuration of the modified simulator employed for the evacuation trials cited in the FAA rulemaking on this subject, the A340-600 employs a number of features that tend to reduce the adverse effects of unusual floor attitudes which could conceivably occur during evacuation. Because of the arbitrarily variable nature of the amount of roll that could be introduced into a discussion of theoretical floor orientations, however, it is recognized that quantitative demonstration of the immunity of any particular design to adverse effects of unusual floor orientation is impossible. At the limit, a 90-degree or greater roll orientation of the floor of course makes it impossible to even consider walking on the aisle surface.

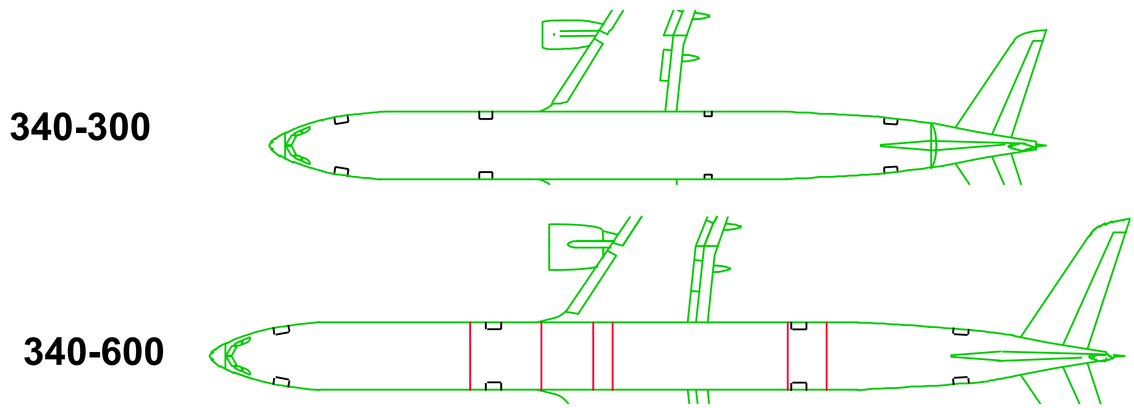
"We emphasize, however, the complete absence of *any* accidents in which accident reports cite evacuation difficulty as being introduced by unusual floor orientation in accidents where fire, smoke or toxic fumes were present. Floor orientation has never been a consideration with regard to certification, even in the 15 years since FAA introduced consideration of this issue in its discussion of emergency evacuation factors in Amendment 25-67. This is so because, while a theoretical issue, it has never been a practical problem in survivable accidents in which rapid egress was important, as evidenced by the lack of even anecdotal information to the contrary. There exist no data to support the importance of floor orientation in emergency evacuation speed, and it represents little more than a theoretical issue. Difficulties that could theoretically arise from unusual floor orientations should not be the dispositive factor in making a decision with regard to emergency exit door spacing.

"Aircraft Design Specific Issues

"General

"The A340-600 is a derivative version of the A340-300. Changes include the engines, a new center landing gear, a larger wing, and a fuselage stretch by 20 frames. These 20 frames are inserted as 11 frames in front of the wing, 3 frames in the center (enlarged wing cord), and 6 frames aft of the wing.

"The 3-frame stretch in the center leads to a 5.2 ft extension compared with the A340-300. The exit distance on the A340-300 between doors 2 and 3 is 55.8 feet. The leaving the doors as is with this insert for the A340-600 would lead to an exit distance of 61 ft.



"Comparison of General Cabin Layouts Showing Added Frames

"The A340-600 is an airplane with a four Type A emergency exits having a maximum passenger seating capacity of 440. The distance between doors 2 and 3 is 73.76 feet. This limits the seating capacity in that zone to 212 seats.

"Design objectives

"The main design objective of the A340-600 is the transportation capability of 440 passengers. The optimum required number of exits for this number of passengers is 4 pairs of Type A (basic on A340-600).

"Other combinations of door sizes are of course possible, for example: A-A-III-B-A, A-A-C-C-A.

"The optimum combination of door size is believed to be A-A-A-A, because it provides uniformity of door size, it provides uniformity of state of the art floor level exits with dual lane passenger flow, it provides for redundant cabin crew at all exit pairs, and if arranged as proposed, the layout provides for the best evacuation flow, and the lowest crew workload during an emergency evacuation.

"The arrangement as proposed allows the cabin crew to stay at their stations during an evacuation. The passenger flow diversion lines in the cabin are reduced to a minimum.

"Optimum door arrangement

"The optimum door arrangement is linked to the distribution of passengers in the cabin, where the distribution of passengers in the 3 zones is 118-212-110. This leads to a door to door distance of 55-74-43 feet in order to obtain an even passenger load for each exit, given the 8 abreast seating in the cabin. Note that the only deviation from literal compliance with the rule consists in an optimum *positioning* of door 3, not the *number* of exits employed.

'A significant design consideration, apart from the door positioning in order to optimize passenger evacuation flow, involved locating door pair 3 to provide for sufficient clearance for ground vehicles that need access to the door during catering and loading, and minimize the risk of damage to the wing by those vehicles.'

"Airbus demonstrates in their petition that the proposed exit arrangement satisfies the criteria for uniform distribution of exits as per AC 25.807-1. In addition, Airbus presented data showing that the exit arrangement of the A340-600 is, in fact, more uniform with respect to passenger distribution than some other Airbus models, which satisfy the 60-foot requirement.

"Evacuation Time in Similar Designs

"The proposed exit arrangement does not have adverse effects on evacuation time, because the distance between doors 2 and 3 is not the limiting factor for the evacuation time. This is clearly shown in the modeling results attached to this petition, and is in agreement with the results of work done on evacuation time limitations since Amendment 25-67 was issued. Simply put, the door/slide combinations are the limiting factors in the evacuation demonstration.

"An evacuation analysis based on tests was conducted for the A340-300 with 440 passengers and 9 cabin crew member (CCM). The A340-600 with 440 passengers and 9 CCM shows an improved passenger distribution over the 4 pairs of exits.

"From the full scale evacuation demonstrations performed on A300, and the A310 the following results for the rate, in passengers per second, of the Type A exit/slide system can be obtained in actual tests with 8 or 9 abreast seating configuration:

Aircraft	Door 1 Type A	Door 2 Type A	Door 3/OWE Type I	Door 4 Type A
A300 B2	1.755	1.526	n.a.	1.759
A310	1.8	n.a.	n.a.	1.788
A310	2.053	n.a.	n.a.	1.833

"In the above-cited cases, even at the lowest (1.526) flow rate, it is clear that evacuation times are in compliance with the requirements of Part 25. The detailed evacuation model results are shown in the (analysis submitted with the petition, which is available in the docket).

"A340-600 Cabin Arrangement

"The cabin arrangement of the A340-600 fulfills all relevant requirements of Part 25, as discussed below.

"Aisles

"Aisles provide an 8 abreast configuration (2-4-2), both cabin aisles 2.5 inches wider than an alternative possibility—a 9 abreast configuration. This positively influences the speed of persons traveling towards the exits, and is also more reliably defensive of blockage by baggage, or deformed seats. Seat arrangements using double seats do not deform to the extent triple seats may in a real accident, because of their improved structural resistance to deformation.

"Seats

"All seats installed comply with the requirements of 14 CFR 25.785 at Amendment 64. This results in a minimum seat pitch of 31 inches for economy class. The seats have no break forward, and this reduces the possibility of persons climbing over seats to reach an emergency exit, with the resultant crowding at and blockage of passageways and exits. As noted above, the lack of break-over also provides stable handholds for persons evacuating the aircraft, a feature not present in the test fixtures employed by FAA in the evacuation tests cited in the preamble to Amendment 25-67.

"Cabin crew stations

"The A340-600 is equipped with 8-9 required cabin crew stations depending on the number of seats installed in the cabin. They are located as follows:

"1 seat door 1 LH	1 seat door 1 RH
1(2) seat(s) door 2 LH	1 (2) seat(s) door 2 RH
1(2) seat(s) door 3 LH	1 (2) seat(s) door 3 RH
1 seat door 4 LH	1 seat door 4 RH

"The cabin crew is distributed in accordance with the following criteria:

"One cabin crew member adjacent each Type A exit and the ninth (for seating configurations from 401 to 440) either at door 2 or door 3.

"The door 2 is likely to be the exit which will be used by the most passengers, because it is in front of the majority of passengers in most configurations, including the highest density configurations.

"The substantial effect of cabin crew on evacuation results have been thoroughly demonstrated by Muir. (See, e.g., Muir and Cobbett, 'Influence of Cabin Crew During Emergency Evacuations at Floor Level Exits,' CAA Paper 95006, 1996.) These tests clearly showed that an improved evacuation capability was achieved with two cabin crew member. This results in the location of the ninth crew member at door 2, where the highest passenger load is to be expected.

"The cabin attendant seats are installed adjacent the emergency exits, and are forward or rearward facing. All seats comply with the dynamic seat testing criteria of

14 CFR 25.561, and 25.562. The seats are arranged to fully comply with the direct view requirements of 14 CFR 25.785.

"Lighting conditions

"The emergency lighting conditions in the cabin are in full compliance with the requirements of 14 CFR 25.812.

"Zone length and zone visibility

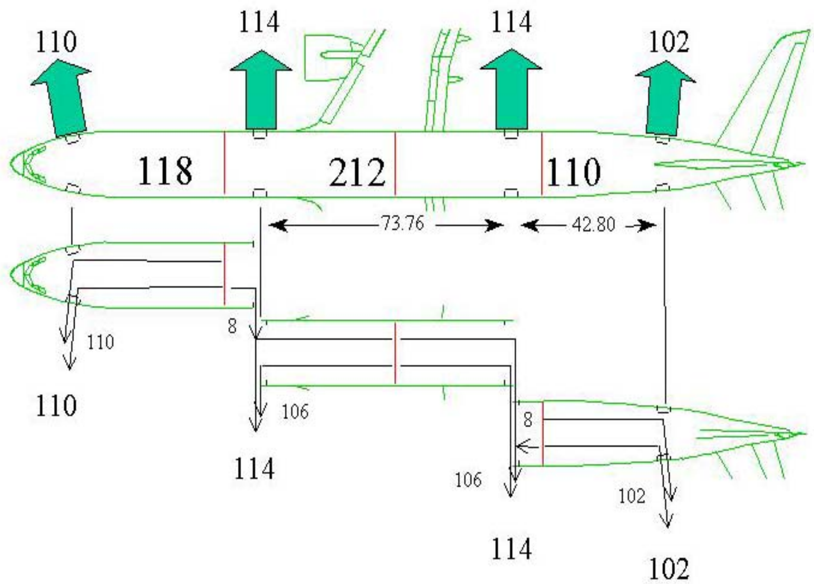
"The length difference between 60 feet and 74 feet does not have a negative influence on the zone visibility. Cabin visibility trials have been made during sessions of the ARAC working group that showed that the cabin and persons in the cabin are visible for a distance of at least 161 feet (Ref.: ARAC Direct View HWG Deliverables, 14 June 1995).

"A340-600 Assist Means

"The A340-600 is equipped with assist means at each floor level exit. There are slide/raft combinations as standard equipment, with slides available as an option. Both are dual lane type assist means and qualified as per TSO C69 b. An assist means at door 3 will be newly developed and comply with standards as prescribed in TSO C69c.

"A340-600 evacuation analysis

"The below figure shows the evacuation plan for the maximum seating capacity of the proposed cabin configuration, using dual flow for the 4 Type A emergency exits, with additional minor flows (1 seat row each) towards exits 2 and 3.



"Using a conservative average rate (see, e.g., Section 3.1.2.3) for dual flow evacuation of 1.713 persons per second, the evacuation times for dual flow (first on ground+passengers and crew/rate) are as follows:

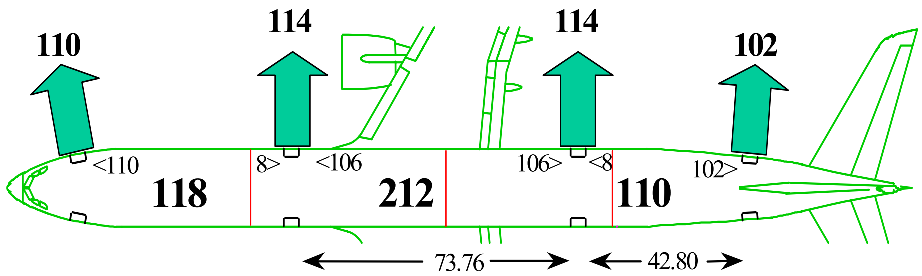
"Door 1	14 + (110 + 5) / 1.713 = 81.13
Door 2	14 + (114 + 2) / 1.713 = 81.72
Door 3	14 + (114 + 2) / 1.713 = 81.72
Door 4	14 + (102 + 2) / 1.713 = 74.71

"Passenger Split Lines

"While in many other FAA certificated aircraft models the split lines can be quite far removed from the exits (and, therefore, the flight attendant station), the A340-600 provides for split lines at doors 2 and 3, and in the center of zone B. This follows an ARAC recommendation stating that split lines should be at the exits, and provides a significant increase in confidence that evacuation flows will be smooth, while at the same time reducing flight crew workload.

"Crew Duties--Proposed

"The design and the evacuation capability do not rely on model-specific crew training. No special crew duties are necessary due to the increased cabin zone length over that of other A340 models. Many comparable aircraft cabins need extra training emphasis, e.g. to require cabin crew to go into the cabin (against the normal evacuation flow) in order to establish split lines. The position of the split lines directly at the doors 2 and 3 leads to lower crew workload in an emergency. The crew member at an inoperative door need not establish a passenger flow division line away from her/his crew station. No special training program is necessary to achieve exit by-pass in order to compensate a design imbalance present in many other high density layouts.



"The crew duties for the exit arrangement above are as follows:

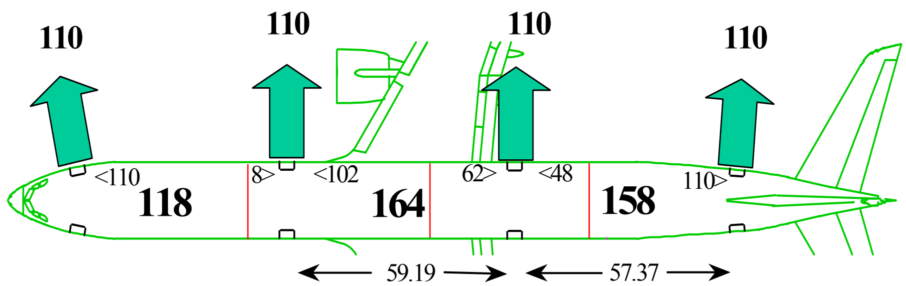
"All CCM check outside condition, try to operate the assigned door if conditions allow safe evacuation.

"Specific tasks

"Door 1 RH open the door and assist passengers into the slide
Door 1 LH direct passengers coming from seating zone A through the LH aisle through the cross aisle to door 1 RH, achieve dual flow,
Door 2 RH open the door and assist passengers into the slide
Door 2 LH1 direct passengers coming from seating zone B through the LH aisle through the cross aisle to door 2 RH, achieve dual flow, direct passengers coming from PSZ A to front exit
Door 2 LH2* assist passengers into the slide at door 2 RH
Door 3 RH open the door and assist passengers into the slide
Door 3 LH direct passengers coming from seating zone B through the LH aisle through the cross aisle to door 3 RH, achieve dual flow, direct passengers coming from PSZ C to rear exit
Door 4 RH open the door and assist passengers into the slide
Door 4 LH direct passengers coming from seating zone C through the LH aisle through the cross aisle to door 4 RH, achieve dual flow

"*increased capability due to 2 CCM assist in evacuation flow

"Cabin Crew Duties—Alternate Layout



"The crew duties for the exit arrangement of the alternative configuration above are as follows:

"All CCM check outside condition, try to operate the assigned door if conditions allow safe evacuation.

"Specific tasks

"Door 1 RH open the door and assist passengers into the slide
Door 1 LH direct passengers coming from seating zone A through the LH aisle through the cross aisle to door 1 RH, achieve dual flow,
Door 2 RH open the door and assist passengers into the slide
Door 2 LH direct passengers coming from seating zone B through the LH aisle through the cross aisle to door 2 RH, achieve dual flow, direct passengers coming from PSZ A to front exit
Door 3 RH open the door and assist passengers into the slide
Door 3 LH go to a position 7 rows in flight direction into PSZ B in order to achieve a division line among the passengers
Door 4 RH open the door and assist passengers into the slide
Door 4 LH1 direct passengers coming from seating zone C through the LH aisle through the cross aisle to door 4 RH, achieve dual flow
Door 4 LH2 go to a position 12 rows in flight direction into PSZ C in order to achieve a division line among the passengers

"Note the distinct operational disadvantages inherent in the alternative layout, which complies with the 60-foot separation requirement. It is quite clear, though impossible to quantify, that there are fewer operational difficulties to be expected with the layout shown in the previous section, despite its technical non-compliance with the exit distance requirements.

"Evacuation path length influence

"High density layout

"In a high density layout the zone exceeding the 60-foot separation requirement can be occupied by up to 220 passengers. The zone is bounded by two pairs of Type A exits, one at each end. The established rate of the A340 exits is 1.675 persons per second and the first on ground time 15 seconds. The time to traverse the slide is 2-3 seconds. The time for the 110th person to jump in to the slide is therefore: (15-3)+(110/1.675)=77.67 seconds. The time available to travel to the exit is 77.67-5=72.67 seconds, or the path 72.67 meter (238 ft) at a speed of 1 m/sec., or 72.67 ft (22.15 m) at a speed of 1 ft/sec. Both values are well beyond the distance of 37 ft for half the distance of a 74 foot long zone.

"Lowest Density

"The evacuation time for an aircraft cabin or cabin zone is determined by the rate of the exit/slide combination of the bounding exits. The rate for the A340 exit/slide combination is established with 1.675 persons/second. The distance between the sitting evacuee and the usable exit is a factor in orderly evacuations in low density layouts.

"In a 74 foot long cabin zone the persons furthest away from the exits are located 37 feet (11.28m) from the nearest exit. Under the assumption that a person moves with 1m/sec. the distance to the exit can be traversed within 11.3 seconds, at a speed of 1 ft/sec. the person reaches the exit at 37 seconds. The first on ground time average is 15 seconds, the sliding time 2-3 seconds, and a reasonable reaction time 5 seconds.

"In example case 1 (1 m/sec.) the furthest person reaches the exit after 5+11.3=16.3 seconds. The time difference is 16.3-(15-2)=3.3 seconds. This is equal to 3.3x1.675=5.697=7 persons. The time difference between the 30 foot path and the 37 foot path is 2.3 seconds or 2.3x1.675=3.852= 4 persons. If the seating density is as low as 8 seats for half the zone distance the eighth person is just in time at a rate of 1.675 persons/sec. If the seating density is as low as 3 persons for half the zone length there is an influence of the zone length on the evacuation time.

"In example case 2 (1 ft/sec.) the furthest person reaches the exit after 5+37=42 seconds. The time difference is 42-(15-2)=29 seconds. This is equal to 29x1.675=48.58=49 persons. The time difference between the 30 foot path and the 37-foot path is 7 seconds or 7x1.675=11.73=12 persons. If the seating density is as low as 50 seats from previous designs for half the zone distance the fiftieth person is just in time at a rate of 1.675 persons/sec. If the seating density is as low as 36 persons for half the zone length there is an influence of the zone length on the evacuation time.

"Summary of Differences from Other Previous Designs

"The A340-600 is different from other designs that have been evaluated with respect to potential exit-to-exit distances greater than 60-feet. Principal among these differences is the symmetrical layout of the A340-600 cabin, with 4 pairs of type a doors spaced almost perfectly uniformly throughout the cabin. In a real accident, elimination of the availability of any one pair of these exits still provides ample backup to provide for swift and easy evacuation. In aircraft with only 3 pairs of Type A exits, and/or with exits distributed non-uniformly throughout the cabin, the non-availability of one of the pairs of Type A exits presents challenges to rapid evacuation of the aircraft from exit overload. The importance of the uniform distribution of the exits is clearly laid out in FAA advisory materials, and as discussed above, the A340-600 almost perfectly meets these criteria in terms of uniform distribution of the exit pairs, and does so with consistency of exit size using the best available exit type. Other designs previously evaluated for potential exemption from the present restriction of exit distance do not meet these criteria

"It would be possible to redesign the A340-600 layout to meet the literal requirements of the subject regulation, but at a sacrifice in this exit uniformity. Moving the third exit pair forward would permit regulatory compliance, but at a cost in evacuation safety. The symmetry called for by Advisory Circular 25.807-1 would be destroyed, and result in precisely the kind of undesirable passenger/exit configurations that the guidance of the advisory circular is intended to eliminate. In addition, this exit pair would now present a complicated, over-wing pathway known to be less suitable in actual evacuation scenarios, and more difficult to maintain for high reliability.

"Another means of compliance would be to replace the pair of Type A exits in position 3 with two pairs of smaller exits, one of which would be further forward (and again present and undesirable over-wing evacuation path). While regulatory compliance would be achieved, the lack of exit uniformity presents more difficulties to the flight attendants in directing passenger flows, presents significantly complicated split lines in terms of those flows, and creates a situation where 40 percent of the exits are sub-optimal in terms of flow capacity, compared to the 100 percent Type A design employed. More exits, in such cases, are not going to be 'better,' because of these non-uniformities, and safety would suffer.

"Having evaluated other potential layouts, and reviewed the aims of the regulation as set forth in Advisory Circular 25.807-1, we believe that the optimum door arrangement is as presented, even though it requires an exemption from the maximum distance criterion of 14 CFR 25.807. Requiring a different design presents operational safety margin reductions by complicating passenger flows, complicating flight attendant duties at critical times in the event of an evacuation, and potentially injects less-than-optimum over-wing exit pathways. The unique symmetry, and full use of state-of-the-art door/slide combinations in 8 Type A exit doors provides the optimum design, one which fully meets the requirements of all applicable regulatory and guidance material but for the distance limitation. The FAA has not been presented with such a situation in previous designs, all of which had deviations in various degrees from the optimum criteria set forth in these materials.

"Concluding Remarks

"The maximum permissible passenger seating standard between two Type A emergency exit pairs in today is 220 seats. This can be achieved within 60-feet using a 10 abreast seating configuration, as has been certificated by FAA. The Airbus family of aircraft has a narrower fuselage, and permits only 8 abreast seating if the increased aisle width standard discussed above is to be maintained. With 8 abreast, the maximum number of seats is reduced by 2, and to maintain the same ratio of people to exit pairs (110 people per pair of Type A exits), the cabin zone must be 14 feet longer.

"We have shown in this petition that the difference of 14 feet in the cabin zone length is not sufficient to have an adverse effect on safety. We have also shown that repositioning the door 3 exit pair results in several adverse consequences, and more importantly, operational disadvantages for cabin attendants in a real evacuation. We have reviewed the basis for the requirement that 60-feet be the maximum exit separation, and have shown that new information developed since this rule was enacted dictates the validity of exemptions, evaluated on a case-by-case basis.

"The A340-600 layout with 4 pairs of Type A exits is optimized, from the safety viewpoint, with a distance between door pairs 2 and 3 of approximately 74 feet. We petition for exemption from compliance with regulatory requirements that would require a less safe cabin exit layout."

Summaries of the petition appeared in the Federal Register on June 6, 2000 and June 23, 2000 (65FR35990 and 65FR39210, respectively). There were 14 commenters on the petition. Four commenters supported the petitioner's request, while ten commenters opposed it.

Summary of Comments Received:

With respect to comments agreeing with the petition, the FAA has the following comments.

Commenters in support of the petition generally agreed with the petitioner's arguments that the arrangement of the exit doors proposed is actually better, from an overall evacuation standpoint, than one where literal compliance with the 60-foot rule is achieved. These commenters also cite the regulatory preamble to amendment 25-67, which notes the regulation is intended to be an interim measure until a suitable performance standard can be identified. These commenters state that the petition demonstrates an equivalent level of safety to the regulations in effect.

The FAA notes that commenters agreeing with the petition do not add any information or arguments to those presented by the petitioner. These commenters have reviewed the petition and agree with its contents. Therefore, these comments will be addressed as part of the FAA's analysis/summary below.

With respect to comments opposing to the petition, the FAA has the following comments.

Commenters opposed to the petition cite various reasons for their position. Several commenters feel that distance between exits is an important safety issue and, regardless of other factors, shorter distances are better than longer distances. Thus, the arrangement proposed by the petitioner can never provide an equivalent level of safety, since it is greater than that permitted by the regulation. Some commenters point out that a grant of this petition would likely be used as a precedent for other proposals and could reopen the issues that were present at the time the regulation was adopted. Commenters believe that a subject of this magnitude should be addressed by a rule change, and that the fact that a performance standard of the sort mentioned in the preamble to amendment 25-67 has not been forthcoming, is not grounds for granting an exemption.

Several commenters disagree with the petitioner's discussion of training and cabin crew performance. Commenters question the validity of an evacuation procedure that depends on passengers using other than their nearest exit. The commenters contend that the procedure described will invalidate the current pre-flight briefing instruction to passengers to "locate your nearest exit." Commenters also note that the evacuation model used to support the petition has not been validated as a tool to show compliance with the regulations. Commenters point out that, in another study conducted by the developers of the computer model used to support the petition, a tendency for passengers to use their nearest exit in actual emergencies was observed. These commenters note that in that study the lack of realism of the emergency evacuation demonstration requirements was cited by the authors. These commenters therefore conclude that arguments with respect to the evacuation demonstration performance are not relevant to the issue of distance between exits, which is only important in an actual emergency.

Some commenters state that the petition does not demonstrate that it is in the public interest, as required by part 11. Regarding whether the petition demonstrates a public interest, *this is the standard* that the FAA must use in granting or denying the exemption, and will therefore be dealt with in the disposition.

When the issue of distance between exits is addressed in isolation of other requirements, it is indeed difficult to reconcile that a longer distance may provide an equivalent level of safety to a shorter distance. In this regard, it is logical to argue for distances shorter than 60-feet which, following the "shorter is better" line of reasoning, would be better still. However, distance between exits is but one of many requirements relating to evacuation, and therefore cannot be taken totally in isolation.

Furthermore, while the regulation is very clear that the requirement is a *maximum* of 60-feet between exits, the fact that it *is* a requirement, and not a scientifically optimized value, constrains the discussion to whether more than 60-feet can be acceptable, and not whether 60-feet is too much. The FAA will discuss this point further in the analysis/summary.

The FAA tends to agree that the subject of distance between exit doors is significant enough that more global regulatory action may be necessary. However, the disposition of this exemption in no way obligates the FAA to take similar action on other petitions, unless all circumstances are the same. It is clear, however, that further rulemaking action was anticipated at the time amendment 25-67 was adopted. The fact that this hasn't taken place does not justify an exemption, as pointed out by the commenter, but neither does it foreclose the possibility that further rulemaking is needed.

Regarding the use of modeling to support the petition, the FAA agrees that the model used has not been validated for use in lieu of full-scale evacuation demonstrations. However, the petitioner is not using the model as a substitute for a full-scale demonstration. As pointed out by other commenters, the full-scale demonstration probably would not be affected by the distance between exits proposed by the petitioner. The use of the model to support the petition is no more or less valid than the use of test data conducted by research institutes, and must be taken in context. The FAA considers that use of modeling in the context of comparing one configuration with another as an illustration is reasonable, considering that the FAA does have experience with the model being used, and is aware of its capabilities and limitations.

Concerning the question of whether the optimum exit for the individual passenger is always the nearest, the FAA will discuss this issue further in the analysis/summary. The FAA agrees that there are conflicting messages with regard to this issue. However, this is not necessarily a function of the distance between exits, and is another instance of one factor that must be taken into consideration in the context of many factors related to evacuation. The FAA does not agree with the commenters' contention that this procedure would invalidate the current pre-flight briefing instruction to passengers to "locate their nearest exit." This is clearly a valuable instruction. Considering that alternative instructions would be to locate a more distant exit, or not to locate any exit, the FAA considers that the current instruction is the most appropriate, regardless of what might occur in an actual emergency.

The FAA also considers that the primary concern and justification for a requirement relating to distance between exits is performance under actual emergency conditions, rather than under demonstration conditions. This issue will be discussed at length in the FAA's analysis/summary.

In addition to comments received during the public comment period, an additional submittal was received from the petitioner while this disposition was in preparation. This submittal, which has been placed in the docket for information, did not affect the

FAA decision in this matter, or alter any of the discussions that appear in this document.

The FAA's analysis/summary is as follows:

The petitioner quotes extensively from the preamble to amendment 25-67, which adopted the requirement for a maximum distance between exits into the regulations. The main focus of the quoted passage is that a performance standard was preferable to a prescriptive requirement on distance between exits, and that the standard being adopted was intended to be replaced by such a performance standard, once developed. There is no question that this was and is the FAA's intention. In fact, as noted by the petitioner, a working group under the auspices of the Aviation Rulemaking Advisory Committee (ARAC) was specifically chartered for that purpose. Also, as noted by the petitioner, no performance standard has been proposed to date.

One of the issues that permeate the petition, as well as comments opposed to the petition, is the relevance of full-scale evacuation demonstration data. The petitioner notes that the full-scale demonstration requirement is, in fact, a performance standard and was rejected by the FAA in considering the issue of distance between exits. In the preamble to amendment 25-67 the FAA "acknowledges that in evacuation demonstrations, aisle distance may not be as critical a factor in evacuation times as it is in real accident emergencies where the aisle may be barely passable." The FAA therefore concluded that the evacuation demonstration "… is not an acceptable performance standard." Thus, while not accepting the full-scale demonstration as adequate to address the issue of distance between exits, the FAA did not reject the notion that it was a performance standard.

Competitive Behavior Tests

The petitioner notes that the regulation was adopted in the 1980's, and that there has been much learned about evacuation in the intervening time. In particular, the petitioner cites the work at the Cranfield Institute of Technology on competitive behavior (evacuation testing with incentive payments for performance, which has been shown to produce behavior similar to that seen in certain accidents.) The petitioner states that, in addition to being more realistic, these tests show that the number of persons between an individual and an exit, rather than the physical distance, is significant in evacuation time. The petition further notes that these tests indicate that constraints in the interior are the limiting factors on egress rate and that no test ever indicated that distance was relevant. Because the cited tests are deemed more realistic, this is considered quite significant.

The FAA agrees that the use of competitive behavior protocols has provided information that was not available at the time the regulation was written. However, the FAA does not agree that the testing conducted addresses directly, or indirectly, distance between exits. While it is clear from the competitive behavior tests that the number of persons has a fundamental bearing on evacuation time, persons were observed to "improve their position" during the evacuation. That is, some evacuees were able to pass other evacuees thereby reducing the number of persons between themselves and the exit from their starting position. Necessarily then, some persons had their relative position worsened over the course of the testing. The FAA considers that the overall relationship of this competitive test to the issue of distance between exits is not that different from the full-scale demonstration required in the regulations. However, in the case of the full-scale test, the evacuees' initial relationship to the exit with respect to other evacuees generally remains constant throughout the demonstration. In the case of the competitive protocol, this relationship can change over time. The end result, however, is that a certain number of persons will evacuate through an exit, and one of them will be last, regardless of whether the evacuation was competitive or not. In addition, the competitive tests were not conducted with distance between exits in mind, so the distances used were not made a variable and were in any case much less than 60-feet. The FAA considers that the competitive behavior testing cited by the petitioner neither supports nor rejects whether distance between exits is significant. In fact, while the competitive behavior tests might be more realistic with respect to evacuee behavior in some accidents, it is doubtful that even these tests can ever replicate the adverse circumstances under which the physical distance between exits may become significant.

Modeling

A major portion of the petition is based on the results of computer modeling, and a comparison of the arrangement proposed for the A340-600, with a previously approved arrangement that complies with the requirement for distance between exits. The petitioner notes that the model predicts essentially equivalent performance for the A340-600 and the previously approved arrangement. The petitioner also notes that the model illustrates that minimizing the average distance traveled by each passenger does not necessarily minimize the total evacuation time, a seeming paradox. The principal difference between the two configurations (other than distance between exits) is the number of seats abreast. The A340 has 8 seats abreast, whereas the airplane under comparison has 10 seats abreast. This results in the same number persons between exits requiring different fuselage lengths at the same seat pitch. This characteristic also leads to the allocation of passengers to exits that was criticized by some commenters as not being reasonable.

The FAA is generally supportive of the development of computer modeling to evaluate evacuation capability. As previously noted, while not validated for use in lieu of full-scale tests, modeling is very useful for other purposes, and has the potential for many advantages over full-scale tests. Chief among them is the ability to perform multiple simulations (rather than a single demonstration), which can add to the confidence of the results. In this regard, the FAA is satisfied that the model predictions with respect to the comparability of the two airplane arrangements discussed are generally accurate. In addition, the FAA generally concurs that the optimum evacuation scenario for the airplane may not be the one in which the specific distance to an exit for each passenger is minimized. That is, the evacuation time may not be minimized by minimizing distance under the conditions analyzed. Whether the conditions analyzed are the only ones of interest will be discussed later. Another feature of a model is the ability to simulate conditions that would otherwise be too hazardous to test, assuming valid data exist with which to build the inputs used by the model. With respect to distance between exits, it is actual conditions that could be significant, rather than demonstration conditions, as is discussed below.

Several commenters expressed concern that the petitioner's discussion of the evacuation procedures for the A340-600, as supported by the modeling results, does not call for the passenger to use the nearest exit. In fact, this is not unique to the A340-600, and is not particularly related to whether the distance between exits exceeds 60-feet. A simple case in point is where the exits are geometrically uniform along the fuselage, but are not of the same type. In this case, the larger exits will be able to accommodate more passengers of a given zone (the portion of the cabin between two pairs of exits) than will the smaller exits, and some people in the zone will use an exit further away, in order to minimize evacuation time. Another example would be where the zones are not of equal size, but all exits are the same type. In this case also, passengers may use other than the nearest exit to minimize evacuation time, even if no zone exceeded 60-feet. With regard to a recommendation that the directing of passengers in a zone to different exits should be done in the immediate vicinity of an exit, the FAA has not yet accepted that concept. The FAA considers this concept to be of questionable practicality. Alternatively, the concept that such passenger division should occur at a specified division point within a zone, although utilized in some certification demonstrations, also may not be practical in an actual emergency. It is the FAA's experience that passengers generally divide themselves in the middle of a zone, with some going aft, and some going forward, unless physically directed to do otherwise. Again, this is under demonstration conditions. Whether divisions at the exit, which are ostensibly easier locations for flight attendants to reach, is superior under actual accident conditions is open to speculation.

Demonstration versus Actual Emergency Conditions

Central to the issue of distance between exits is the relevance of evacuation demonstrations. The petitioner has shown that the increased distance between exits on the A340-600 has negligible effect on the evacuation time for a full passenger complement under demonstration conditions. The petitioner has also proposed that under competitive behavior tests, distance is not an issue. The petitioner further discusses certain research data that were mentioned in the proposal to amendment 25-67, and notes that they are not based on reasonable configurations, or current standards, and thus not a basis for limiting distance between exits to 60-feet. The petitioner also acknowledges that a "theoretical" argument on distance between exits cannot be overcome, since a scenario where such distance is important can always be envisioned; however, the petitioner states that such a scenario has never been found to be a factor in a real accident.

Clearly, distance between exits is only a concern in a real accident. Unless there is a need to evacuate quickly, the distance between exits, in fact the number of exits, is not a concern. As has been previously documented extensively, the evacuation demonstration requirement is not intended to simulate an accident. Under certain accident scenarios, the conditions may be very similar to those encountered in an evacuation demonstration, but unless the *need* for rapid evacuation is realistically simulated, a demonstration cannot be representative. Conversely, the number and variation in potential accident scenarios is effectively infinite. It is for this reason that the regulations contain several requirements that are prescriptive in nature. For example, aisle width, exit size, and emergency illumination levels are all specified in the regulations. Ideally, all factors related to evacuation could be addressed in a global performance standard that would treat the process holistically (as mentioned by the petitioner), without need for such specific requirements. At present, this is not possible. In fact, computer modeling may one day assist in achieving some measure of this objective. In the meantime, however, it will be necessary to address certain issues prescriptively.

In the case of distance between exits, there are several issues raised by the petitioner as to when this is a factor. With regard to the research data mentioned, the FAA noted in the preamble that these data were not the reason for the rule. They were an element of the decision process, but not a justification. The preamble states that "For the FAA to determine that 60-feet is the maximum allowable distance between exits, the FAA does not have to conclude…that 65 feet or 75 feet or even 85 feet would never under any circumstance be safe." The FAA is clear in the preamble that the intent of the requirement is to prevent exit-to-exit distances from growing unchecked. The FAA sees two situations where distance to exits is a factor in an actual emergency.

The first situation is where the physical distance could be a factor when the time available to evacuate is very small. In that case, the time needed to traverse a given distance would be significant. The number of persons involved would still be a factor, but the distance would have the effect of constraining the number of persons as the petitioner has noted.

The second situation is where there are disruptions and other impediments produced by the accident itself. In that case, the further the exits are apart, the higher the probability that a disruption could occur between them.

Neither of these two situations suggests a specific distance between exits. In both cases, the general principal of shorter distances being more desirable than longer distances is clear, but beyond that, there is no suggestion of an optimum value. The FAA tends to agree that there has not been an accident where the distance between exits alone has been a clear survival factor.

<u>Distance versus Other Evacuation Factors</u>

For several of the reasons given by the petitioner, as well as the FAA's overall desire to focus more on performance, this prescriptive requirement is a difficult one to reconcile. In fact, the evacuation of an airplane is a very complex process involving a number of interrelated factors with very little independence among them. As noted previously, in some cases it is necessary as a practical matter to address requirements prescriptively, due to the inability to address all possible scenarios. Distance between exits has thus far been one of those requirements, but the petitioner makes some valid points regarding whether this issue should be treated entirely independently from a regulatory standpoint. For example, the number of seats abreast is an interesting consideration. Using the philosophy that fewer seats abreast could warrant greater distance between exits, a single aisle airplane could conceivably have even greater distance than that proposed in this petition. Conversely, were an airplane to be designed with more than two aisles and more than 10 seats abreast, there could be significantly more persons between exits (assuming the exits were sized accordingly) that were less than 60-feet apart. In addition, the number of aisles is also a factor in a real emergency, since there is an inherent redundancy, and therefore evacuation flexibility, in twin aisle airplanes that isn't present in a single aisle airplane. However, the current regulation treats both equally with respect to distance between exits.

The FAA considers that there are factors related to distance between exits that should be revisited. In particular, the issue of single or multiple aisles is considered of prime significance when considering allowable distance between exits. In addition, the number of seats abreast clearly has an impact on the total number of passengers between exits for the same exit-to-exit distance, and should probably also be considered. However, the FAA does not believe that exit-to-exit distance can simply be extrapolated on the basis of number of seats abreast, or given a "factor" based on whether there is more than one aisle. The FAA *does* consider that these parameters are so closely linked to distance between exits as to warrant some regulatory consideration. These, though, are issues that are fundamental to the requirements themselves and not particular to the A340-600.

<u>Model A340-600 Design Details</u>

The petitioner has argued that the exit arrangement of the model A340-600 is "optimized" and literal compliance with the 60-foot rule would, in effect, provide for an arrangement with less evacuation capability. The petitioner cites the crew duties, proximity of the exits to the wing, and relative exit layout between this airplane and other approved models as justification for this position. In assessing the configuration of the A340-600, the FAA has considered the petitioner's arguments with respect to the "optimum" nature of the arrangement.

There are examples in the fleet of airplanes with 5, 6, 7, 8, 9 and 10 seats abreast with exit-to-exit distances approaching 60-feet. If number of seats abreast were a determining factor, it is conceivable that each of these airplanes could have a different limit on exit spacing. In comparison with an airplane at ten seats abreast, the model A340 requires more longitudinal distance to accommodate the same number of passengers. But, in comparison with the A340, an airplane with only seven seats abreast would require an even longer distance. Clearly, this would not be a practical approach to a certification standard. While the FAA agrees that the number of seats between exits is probably just as important as the physical distance, the proposal is, in fact, to retain the same number of seats over a longer distance. The FAA does not agree that maximizing the number of seats between exits is optimal, and is certainly not something that is assumed to be appropriate for all configurations. Thus, even if there were a way to quantify this factor, in this case there does not appear to be any compensation on that account.

Crew duties are more difficult to assess. The petitioner contends that either relocating the existing exits, or adding exits would complicate crew duties and provide for potentially slower evacuation. The primary reason for this is the need to divide the cabin within a passenger seating zone to optimize evacuation time, if exits are relocated, and use of more than one exit type, if an exit is added. In addition, the petitioner states that use of an exit over the wing is undesirable from an evacuation standpoint due to more complicated evacuation paths.

As previously mentioned, the location of the optimum division line with respect to crew duties in an actual emergency is open to debate. The FAA supports the notion of simplifying crew duties, but it is not clear that the proposed arrangement does that. Neither is it clear, however, that the crew duties imposed by the proposed arrangement would be a problem. In fact, the potential in-service scenarios are so varied as to render any set procedure subject to change as conditions dictate. In this regard, the FAA favors procedures that are adaptable rather than rigid, and that have the aim of minimizing evacuation time under whatever conditions may be present.

The FAA agrees that the use of all exits of the same type has advantages in evacuation from both procedural and design standpoints. That is, using the same design for each exit would likely provide an inherently higher reliability and would simplify evacuation procedures and training. There are, however, a large number of airplane types (including versions of the A340) that incorporate more than one exit type without any known problems. Therefore, the fact that more than one exit type might have to be used on the airplane would not be grounds for granting an exemption. Similarly, there are numerous examples of overwing exits in service with satisfactory evacuation performance. There is even data to suggest that these exits are frequently available in an accident, when other exits are not. Again, the installation of an exit over the wing would not appear to jeopardize the evacuation capability of the airplane. The petitioner has provided data that indicate that the exit arrangement of the model A340-600 is more uniform (geometrically) than that of other approved airplanes that comply with the 60-foot requirement. The FAA agrees that this is a characteristic of the A340-600, and is desirable. However, compliance with each regulation is required. Compliance with one regulation at higher than the minimum standard is not grounds for non-compliance with another regulation. However, these data do reinforce the need to assess evacuation as holistically as possible.

For the reasons discussed above, the FAA does not consider that compliance with the requirement that exits be no more than 60-feet apart would reduce the level of safety of the airplane.

<u>Nature of the 60-Foot Rule</u>

As has been previously discussed, the regulation limiting exit-to-exit distance to 60-feet was clearly intended to provide a boundary on increasing distances between adjacent exits, while performance based criteria were developed. Both the petitioner and the FAA have acknowledged that the "60-foot rule" was intended to be replaced by performance-based criteria at such time as those criteria were developed. Unfortunately, despite extensive efforts, development of performance based criteria has not occurred. There are several reasons that the effort has not been successful, not the least of which is the complexity of the problem. The objective of having a performance standard that would address all evacuation issues remains, but it is clear that characterizing the 60-foot rule as an "interim" measure is no longer valid. The requirement has become a standard that has, at times, dictated design. For the purposes of this petition, it must be assumed that the standard will continue to be in place, and the exemption requested must be considered in light of the level of safety afforded by the standard. While the FAA does not consider that the petitioner has introduced any fundamentally new arguments, the FAA does acknowledge that the use of more recent data and analytical techniques to address the question does lend more credence to the arguments that have been made. The petitioner has presented some strong arguments that the current requirement on distance between exits is not adequate, in and of itself, to address the issues of concern.

Moreover, the consideration of this one parameter in isolation of all other parameters can create different levels of safety for different airplane designs, each of which comply with the requirement. These arguments, while certainly applicable to the model A340-600, are by no means limited to the model A340-600. As previously discussed, there are numerous airplanes with exit distances near 60-feet, and with a range of 5-10 seats abreast. The rationale discussed for the A340-600 exit distance could be applied in some form to all of them. In fact, there is an example in the fleet of an airplane where an exit was added to the basic design to address the issue of distance between exits, where most of the arguments supplied by the petitioner also apply. For the FAA to treat the A340-600 differently from other airplanes would not be in the public interest. Nonetheless, the issues raised do warrant consideration in a wider forum, and the FAA would be willing to entertain discussions on the subject of the regulations in general. In making this statement, the FAA acknowledges the work that has already been done to develop a performance standard to replace the 60-foot rule, and is not suggesting that this effort be repeated. Rather, it appears that consideration of additional variables in conjunction with distance between exits might be appropriate, and that some combination of factors might produce a more comprehensive standard than currently exists. In the absence of a new standard, however, the FAA cannot justify an exemption to the current requirement. Should the petitioner wish to pursue the issue in a regulatory forum, it is suggested that terms of reference be developed to address the issue of distance between exits as part of an ARAC activity.

In consideration of the foregoing, I find that a grant of exemption is not in the public interest. Therefore, pursuant to the authority contained in 49 U.S.C. §§ 40113 and 44701, delegated to me by the Administrator (14 CFR § 11.53), the petition of Airbus Industrie for an exemption from the requirement of 14 CFR § 25.807(f)(4), that adjacent exits be no more than 60-feet apart on the model A340-600 airplane, is hereby denied.

Issued in Renton, Washington, on December 11, 2000.

/s/ Donald L. Riggin
Donald L. Riggin
Acting Manager
Transport Airplane Directorate
Aircraft Certification Service, ANM-100